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Bibimys labiosus Winge, 1887 (Mammalia: Rodentia: Sigmodontinae): new records in Paraná state, southern Brazil, and update of the known geographic distribution

Guilherme Grazzini*, **Josias Alan Rezini**, **Beatrice Stein Boraschi dos Santos**[1], **Fernando José Venâncio**[1], **Fernanda Gatto-Almeida**[2], **Ives José Sbalqueiro**[3], **Iris Hass**[3] and **Liliani Marilia Tiepolo**[2]

1 Hori Consultoria Ambiental, Rua Cel. Temístocles de Souza Brasil, 311, Jardim Social. CEP 82520-210. Curitiba, PR, Brazil
2 UFPR, Laboratório de Biodiversidade e Conservação, Rua Jaguariaíva, 512. CEP 83260-000. Matinhos, PR, Brazil
3 UFPR, Laboratório de Citogenética Animal, Rua Alcides Vieira Arcoverde, s/nº. CEP 81531-990. Curitiba, PR, Brazil
* Corresponding author: guigrazzini@gmail.com

Abstract: *Bibimys* is a genus still poorly known in its basic aspects, such as systematics, natural history and geographic distribution. In Brazil, only *Bibimys labiosus* is recorded, with occasional records spread in time and space. This paper presents four new localities of the species in Araucaria Forest, Paraná state, extending its distribution 150 km southwards. Additionally, a map of the known distribution of the species in Brazil and in Araucaria Forest is provided. The records point toward the lack of knowledge about basic aspects of the small non-flying mammal fauna in the plateau regions of Brazil.

Key words: Southern Brazil, Araucaria Forest, Akodontini

Bibimys is a genus of Sigmodontinae rodent described by Massoia (1979) to hold *Bibimys torresi,* a new species he had described for Buenos Aires province, Argentina. A year later, Massoia (1980) also included *Scaptero-mys labiosus* Winge, 1887 (with known range at Minas Gerais, São Paulo and Rio de Janeiro states in Brazil), and *Akodon chacoensis* Shamel, 1931 (present in Argentinean provinces of Chaco, Formosa and Misiones, and in the departament of Itapúa, Paraguay), under this new genus, but did not provide enough features to enable their taxonomic identification, especially at specific level. D'Elía et al. (2005), in an attempt to elucidate issues related to the taxonomy of *Bibimys*, suggested an emended diagnosis based on several cranial structures, actually insufficient to distinguish the three valid species in the genus. On the other hand, Dyzenchauz and Massarini (1999) and Gonçalves et al. (2005) described karyotypic differences between the species *B. torresi* (2n = 70, FNa = 76) and *B. labiosus* (2n = 70, FNa = 80).

In Brazil, the only known records are those of *B. labiosus* (Figure 1). Since its original description in 1887, only Paglia et al. (1995) recorded the species in the country until 2005, when Gonçalves et al. (2005) refined the species description via morphological and cytogenetic analyses of two males and three females captured in Viçosa, state of Minas Gerais. Later, Martin et al. (2009) presented a record of the species in a eucalyptus plantation of Itapeva, São Paulo state, and Carmo et al. (2014) expanded the known distribution in Minas Gerais state, in Cerrado biome. However, the knowledge about its distribution still shows discontinuity and large sampling gaps. The current paper presents seven new specimens of *Bibimys labiosus* in four new localities of Paraná state, extending the known distribution of the species 150 km southwards. The records are situated in Mixed Ombrophilous Forest (Araucaria Forest) areas, a region of temperate mesothermal subtropical climate (Cfb) according to the Köppen-Geiger's classification

Figure 1. An adult male *Bibimys labiosus* (MHNCI 6479), captured in Piraí do Sul National Forest, Paraná state, Brazil.

Figure 2. Habitats where *Bibimys labiosus* specimens had been recorded in this study, in Paraná state, Brazil. A- HPP-Mauá, municipality of Telêmaco Borba; B- HPP Fundão, municipality of Candói; C- Campo de Santana, city of Curitiba; D- Piraí do Sul National Forest, municipality of Piraí do Sul.

(Kottek et al. 2006). This climate has mild summers, uniformly distributed rainfall, no dry season and the average temperature of the warmest month does not arrive at 22°C. Annual precipitation is between 1,100-2,000 mm (Kottek et al. 2006).

Telêmaco Borba (Locality 1, 24°08′47″ S, 050°33′08″ W, 821 m above sea level (a.s.l.) is situated in an area under influence of the Hydroelectric Power Plant (HPP) of Mauá, on the Tibagi River. It is located in the central-northeastern portion of the state, mid portion of the Second Plateau of Paraná. Montane and alluvial types of the Mixed Ombrophilous Forest are prevalent at this location. However, they are influenced by transitional areas of Seasonal Semideciduous Forest (IBGE 2012). All the remaining forest area in this territory is surrounded by a matrix used for the forestry of exotic tree species, such as *Pinus elliotti*. The two males and a female, all adults (with the third molar hatched), were captured within a private area of Alluvial Forest (IBAMA authorization No. 038/2010) (Figure 2A).

Candói (Locality 2, 25°35′57″ S, 051°51′47″ W, 870 m a.s.l.) is located in an area ruled by the HPP Fundão. It is situated in central-southern area of Paraná state, Third Plateau of Paraná. As for the landscape, there is a predominance of montane and alluvial facies of Mixed Ombrophilous Forest, and the entire location is featured by the presence of a large number of araucarias and cinnamons of the species *Araucaria angustifolia, Ocotea pretiosa, O. puberula* and *O. porosa*. The specimen, adult and male, was captured within a private area of Alluvial Forest, under the influence of the Jordão River (IBAMA authorization number 0731/2010) (Figure 2B).

Curitiba (Locality 3, 25°36′40″ S, 49°19′02″ W, 880 m a.s.l.) is located at county's south region, in the border of Fazenda Rio Grande Municipality, neighborhood of Campo de Santana. One adult male was caught at this locality. This is a peri-urban region characterized by a mosaic comprising remnant native Mixed Ombrophilous Forest in different successional stages, small pine reforestations, small agropastoral properties and a dispersed urban settlement (Figure 2C). The matrix also shows strong degradation caused by sand and clay extraction activities along the Iguaçu riverbed leading to the formation of large pits that become water reservoirs.

Remnants of native forest have different vegetation formations: Montane Mixed Ombrophilous Forest, Alluvial Mixed Ombrophilous Forest, Woody-Grass Steppe and Pioneer Formations with Fluvial Influence (IBAMA authorization number 004/2011).

The Piraí do Sul National Forest (Locality 4, 24°34′40″ S, 045°09′00″ W) is a sustainable use Conservation Unit located at 6 km from the headquarters of Piraí do Sul city. It encompass an area of approximately 153 ha, with 7.2 ha represented by reforestations of *Araucaria angustifolia* and *Ocotea porosa*, 39 ha by reforestation of Pinus species planted in the 1970s and 1980s, 13 ha by firebreaks, and the rest of it (about 93 ha) corresponds to native Araucaria Forest formations in different successional stages. Two adult males were captured at this locality, one of them within a secondary forest at about 1,250 m a.s.l., and the other was found within the reforestation area of *Pinus elliotti*, at about 900 m a.s.l. (License SISBIO 35534-1) (Figure 2D).

All specimens were captured by linear pitfall traps, with buckets of 60 litters connected by black canvas, in different campaigns from 2010 to 2013. The collected specimens were measured and prepared as skin and skulls. Two males from Piraí do Sul National Forest were subjected to direct preparations of bone marrow cells in order to obtain mitotic metaphases to stain with conventional staining (Giemsa). These preparations were performed according to Ford and Hamerton (1956) procedures, but also following the modifications proposed by Sbalqueiro and Nascimento (1996).

In the current paper, we consider metacentric and submetacentric chromosomes as those with two distinct arms (p and q) and the acrocentric chromosomes as those with one arm (q). About 10 metaphases of each specimen were analyzed. Part of the material (skins, skulls, tissues and genetic material) is deposited at the Capão da Imbuia Natural History Museum, Curitiba, Paraná state (MHNCI). Another part is deposited in the scientific collection of Fundação Universidade Regional de Blumenau, Blumenau, Santa Catarina state (FURB). The external measurements are presented in Table 1.

The morphological analysis of the captured specimens is consistent with the redescription by Gonçalves et al. (2005), presenting reduced body size, tail smaller than the size of the body, smooth, long and dense fur homogeneously brown on the back turning lighter in its way to the belly, that have well-defined thresholds,

Figure 3. Labial region of an adult, male, *Bibimys labiosus* (MHNCI 6479), from Piraí do Sul, Paraná state, Brazil, highlighting the short whitish fur at the tip of the muzzle, which present a very conspicuous pink color.

Table 1. Body and skull measurements (mm) and weight (g) of *Bibimys labiosus* specimens caught at four localities of Paraná state, Brazil, the mean of the measures and the standard deviation (SD). (M=male, F=female, Locality 1= Telêmaco Borba, Locality 2=Candói, Locality 3= Curitiba, Locality 4=Piraí do Sul National Forest, TotL=total lenght, TailL= tail length, HF=hind foot length, Ear= ear length, ONL=occipto-nasal length, MRC=molar row-crown length, PBL=palatal bridge length, IFL=incisive foramen length, SH=skull height, NL=nasal length, ZPB=zigomatic plate breadth, IOB=interorbital breadth, ZB=zygomatic breadth, ML=mandibular length).

	FURB 15851 (M)	FURB 15852 (F)	FURB 15853 (M)	FURB 15878 (M)	JAR 104 (M)*	MHNCI 6479 (M)	MHNCI 6480 (M)	Mean	SD
Locality	**1**	**1**	**1**	**2**	**3**	**4**	**4**	**-**	**-**
Date	16.XI.2010	16.XI.2010	16.XI.2010	07.IV.2011	07.VI.2012	20.IX.2012	28.III.2013	-	-
TotL	122	155	165	155	157	147	170	153	16
TailL	-	73	73	62	65	65	73	69	5
HF	22	20	22	22	23	20	22	22	1
Ear	17	14	16	17	17	12	15	15	2
Weight	26	24	25	24	23	24	25	24	1
ONL	27.2	25.8	25.1	24.5	-	25.3	26.5	25.7	1.0
MRC	3.9	3.8	3.6	4.0	-	3.9	4.0	3.9	0.2
PBL	4.1	4.2	3.9	4.0	-	4.0	4.5	4.1	0.2
IFL	5.3	5.2	5.1	5.1	-	5.6	5.5	5.3	0.2
SH	10.4	9.0	9.2	8.6	-	8.6	9.0	9.1	0.7
NL	8.9	8.8	8.4	7.3	-	8.9	11.0	8.9	1.2
ZPB	2.3	2.3	2.6	2.3	-	2.4	2.0	2.3	0.2
IOB	4.5	4.5	4.4	4.2	-	4.5	4.5	4.4	0.1
ZB	13.3	13.4	13.1	12.4	-	12.8	13.5	13.1	0.4
ML	12.4	12.1	12.1	12.0	-	11.0	13.0	12.1	0.7

* This animal will be deposited at the Capão da Imbuia Natural History Museum, Curitiba, Paraná state (MHNCI).

which presents a defined extent (see Table 1 for external and cranial measures). The labial region is covered by whitish short fur and it forms a velvety area on the tip of the muzzle, which is swollen and presents a very conspicuous pink color (Figure 3). The karyotypic analysis for both males from the National Forest of Piraí do Sul revealed diploid number (2n) of 70 chromosomes and fundamental number of autosomal arms (FNa) equal to 80. Among the autosomes, a pair of large submetacentric chromosomes (pair n. 1), five pairs of medium to small metacentric chromosomes (pairs n. 2-6) and 28 pairs of acrocentric chromosomes (pairs n. 7-34), ranging from large (pair n. 7) to small (pairs n. 29-34). The

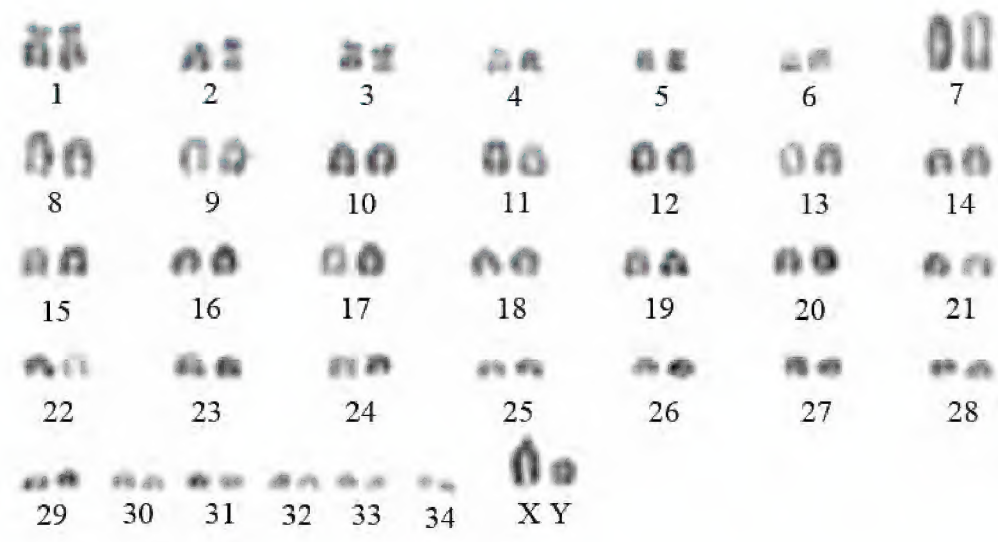

Figure 4. Karyotype, in conventional staining, of an adult male *Bibimys labiosus* (MHNCI 6479), with 2n = 70 and FNa = 80 from Piraí do Sul, Paraná state, Brazil.

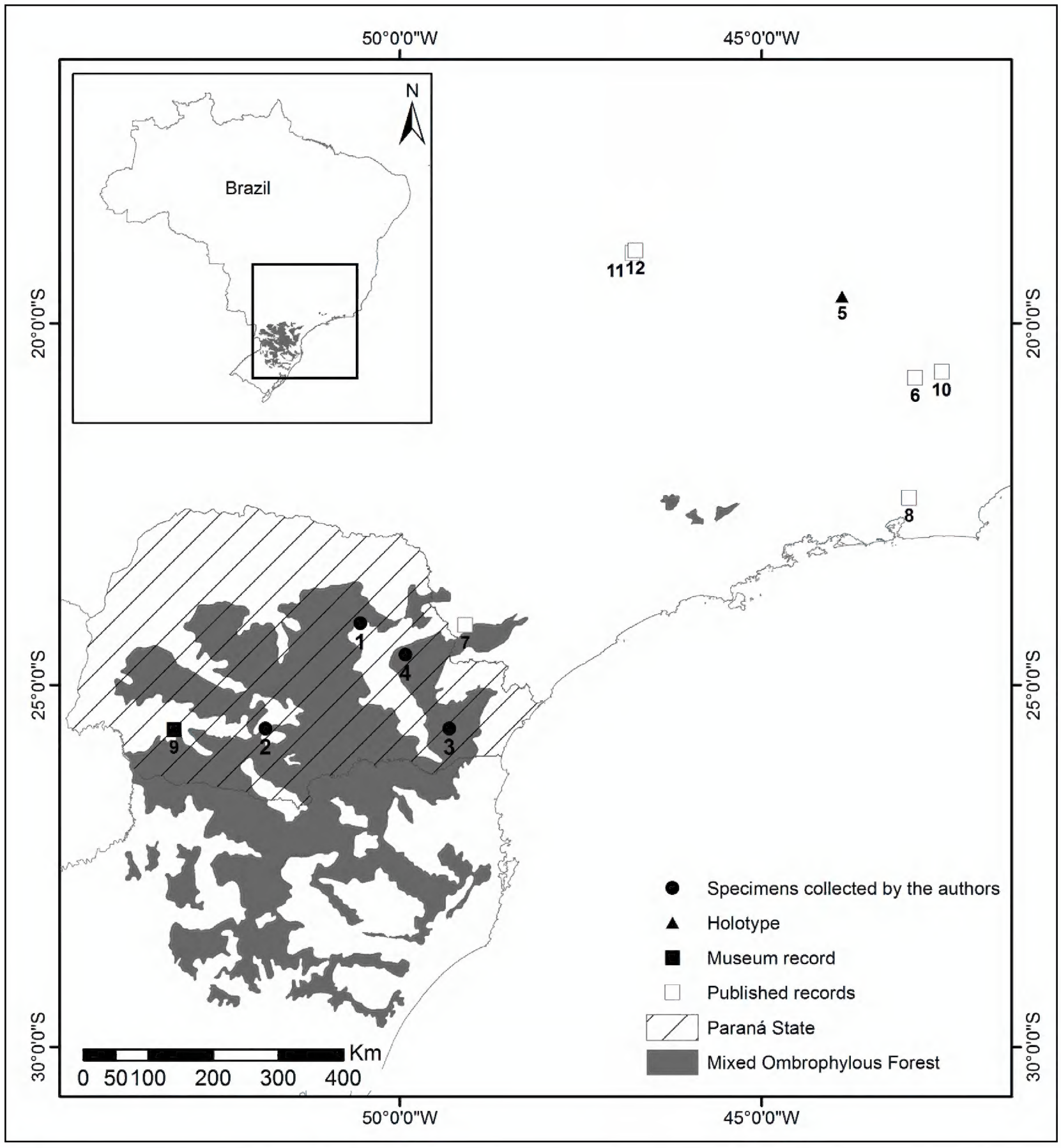

Figure 5. Map of known geographic distribution of *Bibimys labiosus* in Brazil, in Paraná state, and in Mixed Ombrophilous Forest. 1 - HPP Mauá, municipality of Telêmaco Borba, Paraná state (FURB 15851, 15852 and 15853); 2 - HPP Fundão, municipality of Candói, Paraná state (FURB 15878); 3 - Campo de Santana, city of Curitiba, Paraná state (JAR 104); 4 - Piraí do Sul National Forest, municipality of Piraí do Sul, Paraná state (MHNCI 6479 and 6480); 5 - Lagoa Santa, Minas Gerais state (Winge, 1887 - Holotype); 6 - municipality of Viçosa, Minas Gerais state (Gonçalves et al. 2005); 7 - municipality of Itapeva, São Paulo state (Martin et al. 2009); 8 - municipality of Teresópolis, Rio de Janeiro state (Carmo et al. 2014); 9 - municipality of Cruzeiro do Iguaçu, Paraná state (MHNCI 5041); 10 - municipality of Arapongas, Minas Gerais state (Carmo et al. 2014); 11 - municipality of Patrocínio, Minas Gerais state (Carmo et al. 2014); 12 - municipality of Cruzeiro da Fortaleza, Minas Gerais state (Carmo et al. 2014).

X chromosome is a large acrocentric, with size between pairs 7 and 8, and the Y chromosome is a median acrocentric, equivalent in size to pair 15. This karyotype corresponds to the one described by Gonçalves et al. (2005) (Figure 4).

After including the new records, the geographic distribution map of *Bibimys labiosus* is shown in Figure 5. The discontinuity of its distribution points towards the need for further inventory studies on Brazil's inland forest formations. In addition, the fact that seven of the new specimens were performed by pitfall traps highlights the importance of using this capture method in other studies conducted in the Atlantic Forest Biome, as already evidenced by Umetsu et al. (2006). Thus, inventories must make use of different sampling methods and combination of morphological, cytogenetic and molecular analyses for accurately identifying taxa.

Forest formations associated with the Mixed Ombrophilous Forest of the Southern Plateau of Brazil are currently severely retracted from their original distribution due to various historical factors from anthropic origin. The record of *Bibimys labiosus* in Paraná state expands its distribution to one state in southern Brazil and highlights its presence in Araucaria Forest, where the species was not yet known to occur (Ribeiro and Vieira 2012).

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